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Trends in Homeownership by Age and Household Income: Factors Associated with the Decision to Own, 1981 to 2006

by W. Mark Brown and Amélie Lafrance

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^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

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Statistics Canada, Economic Analysis Division

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Abstract

This paper examines why rates of homeownership have been increasing amongst young higher-income households, but declining among young lower-income households. For the period from 1981 to 2006, household data from the Census of Population, supplemented with information from the Survey of Financial Security, are employed to model the decision to own across the income distribution. The model assesses whether housing market conditions (e.g., the cost of renting versus owning), the financial condition of households (e.g., whether the household has sufficient wealth to make a standard down payment), and demographic factors (e.g., changing family composition) account for these diverging trends in housing demand.

Key words: housing, housing tenure choice

Executive summary

One of the most important financial decisions that Canadian households make is the decision to own, rather than rent, their homes. For younger households, homeownership can be a financial challenge, as mortgage payments often account for a significant portion of household income. For older households, their homes often represent a large asset that provides a substantial implicit, tax-free income and one that may be eventually liquidated and turned into income. Therefore, the decision to own is one that affects household finances throughout the life cycle. It is simultaneously a decision about how to provide shelter and where to invest household savings in order to support future consumption.

Recent analyses suggest that the tendency of Canadians over the last four decades has been increasingly to own rather than rent. However, these aggregate statistics mask diverging trends across income classes. Rates of homeownership have fallen among young lower-income households, but have risen for young upper-income households. The picture that emerges, therefore, is that of a generalized trend towards increased homeownership, but one in which gains in homeownership may be concentrated toward the upper end of the income distribution.

This paper investigates the degree to which changes in demand-side, economic incentives account for the divergent trends in homeownership across the income distribution. In theory, the decision to own depends largely on the cost of owning relative to renting an equivalent dwelling, household income, and household wealth. If these economic incentives have shifted differentially across the income distribution, then part of the divergent trends in homeownership between lower- and upper-income households may be traced to these standard economic forces. If these trends are not accounted for by these demand-side factors, then it may be necessary to expand the scope of future work to the supply-side of the market.

This paper also takes into account a range of socio-demographic factors that may also underlie these divergent trends. Since 1981, the demographic profile of households has shifted away from couples with children and towards single persons who are less likely to own, and this shift has been most pronounced amongst younger lower-income households.

By testing the association between the economic and demographic characteristics of households and the decision to own across the income distribution, this paper provides two types of information. First, it assesses the degree to which economic incentives associated with the decision to own are able to account for the divergent trends in homeownership across the income distribution. That is, are these changes simply a reflection of the changing nature of the demand side of the housing market? Second, if these economic forces cannot account for these divergent trends in homeownership, the evidence would suggest that a substantial structural shift has taken place in the housing market which has had a differential effect across the income distribution. This being the case, future research would have to push beyond the standard economic incentives associated with the decision to own a home.

What are the overall trends in homeownership?

Between 1981 and 2006, Canadians increasingly chose to own, rather than rent, their homes. Over this period, homeownership in Canada increased by 7 percentage points, from 62% to 69%. This trend would likely have been even stronger if it were not for the tendency for Canadians to delay family formation, which often coincides with the purchase of a first home.

Although homeownership has become an increasingly popular alternative to renting, this trend is not universally true of all households. For couples aged 20 to 39 with children in the bottom income

quintile, homeownership fell from 47% to 35% between 1981 and 2006 while, for young couples with children in the top income quintile, homeownership increased from 88% to 94%.

Non-family individuals have also turned progressively towards owning. This is true of both lower- and higher-income households in this group, but the trend is stronger for higher-income households. Young non-family individuals aged 20 to 39 in the bottom income quintile saw their rate of homeownership rise from 9% to 17%, while the same type of household in the top income quintile saw the rate of homeownership rise from 38% to 60%.

What factors are associated with the decision to own?

As expected, households are more likely to choose to own their homes when the cost of renting relative to owning is higher, a finding which suggests that rental housing and owner-occupied housing are substitutes. However, this is the case only for lower- and middle-income households. For households in the top income quintile, there is no association between the relative cost of renting and homeownership. There is little evident interaction between the rental and owner-occupied housing markets at the top end of the income distribution. Households are also more likely to own when the house price-to-rent ratio is higher. A rising price-to-rent ratio is consistent with rising expected gains in house prices that would make housing a more attractive place to invest household savings. Not surprisingly, households are less likely to own as the ratio of mortgage-carrying costs to income rises.

It is also the case that households with higher permanent incomes and sufficient wealth for a standard down payment are more likely to own. This is consistent with the fact that owning a home provides a greater tax advantage for higher-income homeowners with higher marginal tax rates. It is also consistent with borrowing constraints (i.e., minimum down payment requirements) negatively affecting the ability of households to finance a home.

To what extent do economic factors account for the differing trends in tenure choice across income quintiles and household types?

After accounting for standard demand-side economic incentives, by and large the trends in the data remain. Lower-income households in relative and, at times, absolute terms are less likely to own relative to higher-income households. There is an apparent structural change in the housing market that cannot be fully accounted for by demand-side factors.

Controlling for demand-side incentives reveals an important change in the housing market that occurred between 1981 and 1986. Over this period, there is a significant decline in the probability of owning a home that persists to the end of the study period.

1 Introduction

One of the most important financial decisions that Canadian households make is whether to own, or rent, their homes.[1] For younger households, homeownership can be a financial challenge as mortgage payments often account for a significant portion of household income (Hamilton 2001). For older households, the home often represents a large asset that provides a substantial implicit, tax-free income (Brown *et al.* 2010) and one that may be eventually liquidated. Therefore, the decision to own is one that affects household finances throughout the life cycle. It is simultaneously a decision about how to provide shelter and a decision about where to invest household savings to support future consumption.

Over the last four decades, Canadian households, on average, have increasingly chosen to own, rather than rent, their homes. Between 1971 and 2006, homeownership rates rose from 63% to 70% (Hou 2010). However, these aggregate statistics mask diverging trends across income classes and household family types. Over the same 35-year period, homeownership rates among young households aged 20 to 34 in the lowest income quintile fell from 31% to 19% while, for households of the same age in the upper income quintile, homeownership rose from 38% to 77%. Further subdividing the data to take into account family structure reveals the same basic pattern. For young couples with children, homeownership fell in the lowest income quintile (42% to 37%), but rose in the top income quintile (65% to 94%). For young non-family individuals, homeownership increased for both the bottom (9% to 14%) and top (13% to 60%) income quintiles, but the trend towards homeownership was strongest at the top of the income distribution (Hou 2010). The picture that emerges, therefore, is that of a generalized trend towards increased homeownership, but one in which gains in homeownership are larger at the top of the income distribution.

This paper investigates the degree to which changes in demand-side driven economic incentives to own account for the divergent trends in homeownership across income classes and family types. In theory, the decision to own depends on several factors, including the cost of renting relative to owning an equivalent dwelling, household income, and household wealth. If rental and owner-occupied housing markets are out of equilibrium, there will be an incentive for households to switch between owning and renting. Because the (implicit) returns on the home are not taxed, within a progressive tax system, higher-income households have a greater incentive to own. Similarly, households with more wealth are more likely to overcome borrowing constraints. If these economic incentives vary across the income distribution, then part of the divergent trends in homeownership between lower- and upper-income households may be traced to these economic forces. If these standard demand-side factors do not account for these trends in homeownership, then it may be necessary to expand the scope of future work to include the supply-side of the market.

The paper also takes into account a range of socio-demographic factors that may also underlie these divergent trends. For instance, non-family individuals are less likely to own than couples, particularly couples with children. Since 1971, the demographic profile of households has shifted away from couples with children and towards single persons, and this shift has been most pronounced among younger lower-income households (Hou 2010).

By testing the association between the economic and demographic characteristics of households and the decision to own rather than rent across the income distribution, this paper assesses the degree to which canonical economic factors associated with the decision to own are able to account for the divergent trends in homeownership across the income distribution. The paper also assesses

1. On average, owner-occupied dwellings accounted for about 40% of household assets, and home mortgages accounted for 62% of household liabilities for households and unincorporated businesses in 2009 (CANSIM table 378-0051).

whether these changes simply reflect the changing nature of the demand-side of the housing market. It examines whether the cost of renting relative to owning changed over time and whether the cost of equivalent owner-occupied housing shifted in favour of those households at the top of the income distribution. It asks whether access to wealth for a standard down payment reduced the tendency of lower-income households to enter the housing market. And it relates changes in these determinants of housing demand to outcomes. If these canonical factors cannot account for these divergent trends in homeownership, it is likely that there has been a substantial structural shift in the housing market which has had a differential effect across the income distribution. This being the case, future research would have to focus more on changing supply-side conditions and search for unobserved characteristics of these sub-populations that may influence the decision to own.

The remainder of the paper is organized as follows. Section 2 elaborates on the factors that are expected to influence the choice of owning versus renting. It is followed, in Section 3, by a descriptive analysis that addresses the question of whether trends in homeownership rates have differed over time across income classes and family types and the extent to which aggregate rates of homeownership have been accounted for by changes in family structure. The remaining two substantive sections of the paper take up the multivariate analysis of the choice to own a home. The first, Section 4, presents the model to be estimated and the extensive data development required for the estimation. The second, Section 5, presents the multivariate estimates. This is followed by the concluding section to the paper.

2 Standard treatment of the decision to own versus rent

The decision to rent or to own a home is one of the most significant choices that households make. It involves a decision as to the form that the consumption of housing services will take and how household savings will be invested. The former addresses the question of whether it is more advantageous for a household to obtain housing services from a landlord or to provide these services to itself by owning a home. The latter addresses the question of whether the household expects to obtain a higher (risk-adjusted) rate of return by investing its savings in a home than from other forms of investment. Both motivations for owning a home are addressed in the discussion to follow.

In its standard demand-side treatment, the tenure-choice decision takes into account the cost of renting relative to owning, the income of the household, household wealth, and a series of demographic characteristics of the household (see, for example, Goodman 1988). Each of these underlying factors is discussed in order below.

2.1 The cost of renting relative to owning

From a strictly theoretical perspective, if the household had perfect foresight and there were no contracting costs, the household would be indifferent between owning and renting (Hansen and Skak 2005). Within this construct, user costs (C) and rents (R) would provide equivalent measures of housing services. The user cost of an asset in equilibrium can be thought of as the price that the owner of an asset would demand when renting out the asset for a given period of time. The user cost is equal to the opportunity costs of funds used to purchase the asset plus depreciation, maintenance costs, and taxes incurred over the length of time the asset is rented, less the expected appreciation of the asset. In mathematical terms, user costs are given by:

$$C_t = (r_t + z_t - a_t) P_t = R_t, \qquad (1)$$

where, for some year t: r is the rate of return on capital; z is the combined rates of depreciation, maintenance, and insurance, plus the property tax rate; a is the expected rate of appreciation; and P is the house price.

Rent is included in equation (1) because, in equilibrium, the user cost of a dwelling is expected to equal the rental rate. When user costs are below (above) the rental rate, there will be an incentive, on the margin, for agents to switch from renting (owning) to owning (renting). This will put upward (downward) pressure on house prices and downward (upward) pressure on rental rates. The cost of renting relative to owning will influence the tenure decision of households only when the housing market is out of equilibrium.

Of course, the equalization of rental rates and user costs depends on a set of assumptions that are not necessarily realized (Gillingham 1983), because there are additional forces that influence both user costs and rents and, more broadly, the decision to own. As noted by Halket and Pignatti (2010), there are many frictions favouring renting, such as higher transaction costs associated with homeownership (see Haurin and Gill 2002 and Díaz and Luengo-Prado 2008). Yet, there are also frictions that may favour owning. For instance, imputed rent is not taxed. In a progressive tax system, this will create an incentive for higher-income individuals to own rather than rent (Swan 1981 as cited in Hansen and Skak 2005). Furthermore, unlike owner-occupiers, renters do not incur the full costs of the consumption of housing,[2] and this leads to higher rates of wear and tear. These additional costs are passed on to renters by the landlord in the form of higher rents that are above what an owner-occupier would charge to himself or herself for the same asset (Henderson and Ioannides 1983). Regardless of whether the cost of owning is systematically above or below the cost of renting, their relative value may still affect the tenure decision on the part of households, where a shock to one form or another may induce more households to switch between these two types of housing tenure.

2.2 Household income

As noted above, households are expected to own rather than rent when their incomes increase, because the implicit returns to owner-occupied housing are not taxed. It is argued further that, because housing consumption and tenure are longer-term decisions, permanent income should be used to measure the propensity of a household to own (Haurin *et al.* 1996).

It is not just the level of income that affects the housing decision. There is an extensive theoretical and empirical literature that points to the role of uncertainty regarding income levels and tenure choice (Fu 1995; Robst *et al.* 1999), which is particularly relevant for younger households (Fisher and Gervais 2009). Theoretically, the relationship between earnings risk and homeownership is ambiguous (Fu 1995; Fisher and Gervais 2009). On the one hand, greater uncertainty increases the incentive to save. Higher savings, in turn, will ease the transition from rental to owner-occupied housing. On the other hand, the option value of waiting increases with the uncertainty of future incomes[3] when transaction costs are proportional to the value of the asset (Fisher and Gervais 2009). Most studies that assess the effect of uncertainty on homeownership find a negative

2. Renters do not incur the full cost of utilizing a housing asset, because rental contracts are unable to specify all the contingencies that could account for the increased wear and tear caused by a given tenant. Because tenants do not incur the full cost of utilizing the asset, this will lead to greater wear and tear on the same asset by renters than by owner-occupiers. In the standard user cost framework, this implies that rates of depreciation are higher for the landlord than for the owner-occupier of the same asset. Hence, *ceteris paribus*, it is more costly to rent rather than own the same dwelling. This is analogous to the classic "lemons" problem (Akerlof 1970).
3. See Pindyck (1991) for a standard treatment of the option value of investment under conditions of irreversibility and uncertainty and Burda (1995) for a (roughly) analogous application to the decision to migrate.

relationship (Robst *et al.* 1999; Diaz-Serrano 2005; and Fisher and Gervais 2009) and observe that its effect is strongest among younger households that are least able to absorb an income shock (Díaz and Luengo-Prado 2008).

2.3 Borrowing constraints

Because most households do not have the wealth to purchase their homes outright, they have to rely on the mortgage market. Banks typically ration the loans that they are willing to extend in accordance with minimum down payment requirements and requirements regarding the proportion of household income required to maintain payments. Linneman and Wachter (1989) found a significant negative relationship between both income-related and wealth-related borrowing constraints and homeownership. Haurin *et al.* (1997) obtained similar results while also taking into account the endogeneity of incomes and wealth with respect to homeownership. Subsequent work also confirms the importance of borrowing constraints (Bourassa and Hoesli 2010).

2.4 Housing as an investment

The tenure decision depends not only on the question of how housing services will be provided, but also on how households choose to deploy their savings, as owner-occupied housing is also a form of investment (Goodman 1988). That is, if there were an increase (decrease) in the expected capital gains from owning, there would be an increasing incentive to own (rent), rather than rent (own), a dwelling, independent of the relative cost of owning and renting (if it is assumed that owner-occupiers and investors expect the same capital gains).

To see this more clearly, consider two identical condo units, one owner-occupied and the other rented out by an investor. All else being held equal, the user cost to the owner-occupier and investor will be the same. Hence, if the housing market were in equilibrium, the rent charged by the investor would equal the user cost to the owner-occupier for the same unit. If there were to be an increase in the expected appreciation in house prices, the user cost to the owner-occupier and the investor would fall. If prices freely adjust, the relative cost of renting and owning would remain unchanged. However, the value-to-rent ratio would have increased, both because the expected higher rates of appreciation which result in a higher price for the condo and because the rental price would have fallen. It is based on this logic that Goodman (1988) argued that the value-to-rent ratio should be taken into account when assessing the factors that influence the choice of households to rent rather than own. This interpretation has to be treated with some caution, however, because the value-to-rent ratio does not depend solely on expected capital gains. For instance, a fall in interest rates could also induce rising house prices relative to rents as house prices rise in reaction to falling interest rates (Smith and Smith 2006).

2.5 Household demographics

The incentives to own versus rent will vary across the life cycle. Younger households will not have had the time to accumulate sufficient wealth for a down payment, causing them to delay owning a home. Because of this, borrowing constraints may more be binding for these households. Moreover, because younger households are more mobile, they will be less willing to incur the transaction costs associated with purchasing a home and, therefore, will have an additional incentive to rent. Hence, even when borrowing constraints are taken into account, younger households may be less likely to own.

The essential conclusion to be drawn from theory is that there are potentially strong incentives for renters to switch to owner-occupied housing and vice versa as economic circumstances change.

The extent to which these conditions have affected the buy-versus-rent decision is an empirical question that is addressed in subsequent sections.

3 Trends in homeownership rates

Prior to examining the factors that affect a household's decision to rent or own a home, it is useful to establish the broad trends in homeownership in Canada. This is done first for all households and then by type of household by using the Census of Population (1981 to 2006). In the multivariate analysis to follow, a routine is employed to match owner-occupied and rental dwellings in order to calculate the cost of renting relative to owning. This results in the loss of 5% of the sample because of poor matches. To conform to the sample used for multivariate analysis, the descriptive statistics presented below are based on the reduced sample.[4]

Throughout the study period, homeownership increased in Canada (see Table 1 and Chart 1). Early in the period, homeownership rates increased slowly, rising only 2 percentage points in the first 15 years. However, after 1996, homeownership rates increased more rapidly, rising by 5 percentage points in just 10 years.

As expected, homeownership increases with age and with income (see Table 1). Most households make the transition from renting to owning in their 20s and 30s. By the time households enter the 30-to-39 age class, about 6 in 10 are homeowners. It is, therefore, these young households that will receive the most attention in the descriptive and multivariate analysis to follow.

Before delving more deeply into homeownership patterns among younger households, it is worth noting homeownership trends for older households. Households aged 70 and over experienced some of the strongest gains in homeownership over the period. In 1981, two out of three of these older households owned a home. By 2006, this proportion had risen to 8 out of 10. This is a pattern that holds across most income quintiles (see Table 1). Rising rates of homeownership among older households stem from higher rates of homeownership across succeeding age cohorts over this period (Hou 2010) and from the fact that people may be staying in their own homes longer as they age.

As was noted in the introduction, trends in homeownership in aggregate mask significant differences across households classified by income and family type.

4. These estimates will be slightly different than those in Hou (2010) because of differences in age class and because the descriptive statistics are based on a matched sample of owners and renters where 5% of the sample is lost as a result of a poor match between owner-occupied and rental dwellings. The matching routine is discussed further in the Appendix.

Table 1
Homeownership rates by age class and income quintile, 1981 to 2006

	1981	1986	1991	1996	2001	2006
	homeownership rates (percent)					
All households	62	63	63	64	66	69
Age class						
20 to 29	33	31	29	28	29	34
30 to 39	65	62	59	58	59	63
40 to 49	74	73	72	70	71	73
50 to 59	75	76	76	75	76	77
60 to 69	70	73	73	75	76	77
70 and over	66	69	71	74	77	78
Bottom quintile						
Age class						
20 to 29	13	12	10	9	11	13
30 to 39	33	28	24	22	24	26
40 to 49	43	40	35	33	34	37
50 to 59	51	50	47	45	45	46
60 to 69	55	55	54	53	55	53
70 and over	56	54	56	52	57	56
Second quintile						
Age class						
20 to 29	22	22	21	19	21	26
30 to 39	48	44	41	38	41	44
40 to 49	58	57	52	50	51	55
50 to 59	64	66	65	63	63	64
60 to 69	70	73	73	75	76	76
70 and over	71	73	73	75	78	78
Middle quintile						
Age class						
20 to 29	37	35	35	36	37	44
30 to 39	64	60	61	58	61	64
40 to 49	72	70	69	67	70	72
50 to 59	75	76	76	75	76	77
60 to 69	76	79	81	83	85	85
70 and over	74	77	80	82	85	86
Fourth quintile						
Age class						
20 to 29	51	49	49	53	51	62
30 to 39	76	75	75	76	76	81
40 to 49	81	81	81	82	83	85
50 to 59	82	84	84	85	85	87
60 to 69	81	84	86	88	89	90
70 and over	77	81	84	87	89	90
Top quintile						
Age class						
20 to 29	60	59	59	62	59	74
30 to 39	84	84	83	85	85	90
40 to 49	89	90	90	91	92	94
50 to 59	89	91	92	92	93	95
60 to 69	86	89	91	92	93	95
70 and over	81	85	88	91	93	94

Source: Statistics Canada, Census of Population, 1981 to 2006.

Homeownership increases consistently from the bottom to the top income quintile for each age class (see Table 1). Over time, gains in homeownership rates were weakest in the lower income quintiles, particularly among younger households (i.e., those in the 20-to-29 and 30-to-39 age classes). Trends in homeownership followed a U-shaped or unfinished U-shaped pattern, with generally declining rates in homeownership until 1996 and rising rates afterwards. Overall, these young, lower-income households experienced modest gains in homeownership over the 25-year study period. In contrast, rates for households in the top income quintile increased, albeit with most gains occurring in the 2000s for the younger households.

Why homeownership for younger lower-income households has been in relative—and, in some instances, absolute—decline is open to question. Evidence from the U.S. suggests that this trend stems, in part, from the increasing tendency of individuals to delay family formation, which is positively associated with the transition from renting to homeownership (Fisher and Gervais 2009).

The distribution of the sample across household types by income quintile is shown in Table 2 for the two youngest age classes (20-to-29 and 30-to-39). For all income quintiles, the share of couples with children has been falling, while the share of non-family individuals has been rising. The reduction in family formation, however, was most prevalent in lower-income households. For the bottom income quintile, the proportion of couples with children fell from 25% to 14% between 1981 and 2006, while the share of non-family individuals rose from 39% to 53%. This stands in contrast with the top income quintile, whose demographic structure remained largely static over the period.

The delay in family formation illustrated in Table 2 may significantly affect overall rates of homeownership if non-family individuals are less likely to own. Hence, a simple explanation for static or declining homeownership amongst younger lower-income households could be the changing nature of family structure between 1981 and 2006.[5]

One way to assess the effect of this shift in family structure is to impose the counterfactual that the family structure of households did not change over the period and to ask how much the rate of homeownership would have changed if this had been the case. Mathematically, this counterfactual can be calculated from the following:

$$\tilde{r}_{t+n} = \sum_f s_{ft} r_{ft+n}, \qquad (2)$$

where: s is the share of family class f at the start of period t (1981); r is the rate of homeownership; and n is the number of years from the start of the period.

Chart 1 traces actual and counterfactual homeownership rates for all households between 1981 and 2006.

5. As a result of possible economies of scale at the household level, dual-earning couples may find it easier to purchase a home (e.g., because it is easier for them to save for a down payment on a home). To test for this possibility, household income was divided by the square root of the household size. Homeownership rates and trends therein across income quintiles based on this adjusted income were not qualitatively different from those based on unadjusted income levels.

Table 2
Distribution of households aged 20 to 39 in the sample, by family type, 1981 to 2006

	1981	1986	1991	1996	2001	2006
	share of households (percent)					
Bottom quintile						
Family type						
Couple with children	25.2	22.0	18.7	18.0	16.4	13.6
Couple no children	9.7	9.5	8.8	8.2	9.1	10.3
Male lone parent	0.8	1.2	1.3	1.6	1.4	1.3
Female lone parent	24.8	27.3	27.8	28.5	25.3	22.1
Non-family individual	39.4	40.1	43.4	43.6	47.7	52.7
Second quintile						
Family type						
Couple with children	41.5	38.8	35.2	33.4	30.2	29.2
Couple no children	15.5	15.9	14.8	13.7	14.0	15.5
Male lone parent	0.9	1.1	1.3	1.5	1.8	1.7
Female lone parent	8.1	10.1	10.7	14.1	14.1	13.5
Non-family individual	34.1	34.1	38.0	37.3	40.0	40.0
Middle quintile						
Family type						
Couple with children	56.4	52.7	51.8	47.7	47.1	43.0
Couple no children	20.0	19.1	20.0	18.6	20.1	21.8
Male lone parent	0.9	1.1	1.2	1.3	1.5	1.4
Female lone parent	2.9	4.5	4.1	5.7	5.8	5.4
Non-family individual	19.8	22.6	22.9	26.8	25.4	28.4
Fourth quintile						
Family type						
Couple with children	61.7	61.9	59.6	59.8	55.0	54.0
Couple no children	25.1	22.7	24.9	22.5	25.8	27.0
Male lone parent	0.7	0.9	0.8	0.9	0.9	0.9
Female lone parent	1.5	2.1	1.8	2.5	2.6	2.4
Non-family individual	10.9	12.4	12.9	14.3	15.7	15.8
Top quintile						
Family type						
Couple with children	60.6	61.9	60.0	61.6	58.0	59.1
Couple no children	27.6	26.2	27.2	25.9	28.8	29.6
Male lone parent	0.6	0.8	0.6	0.5	0.6	0.6
Female lone parent	1.2	1.6	1.2	1.5	1.6	1.4
Non-family individual	10.1	9.5	11.0	10.5	11.0	9.3

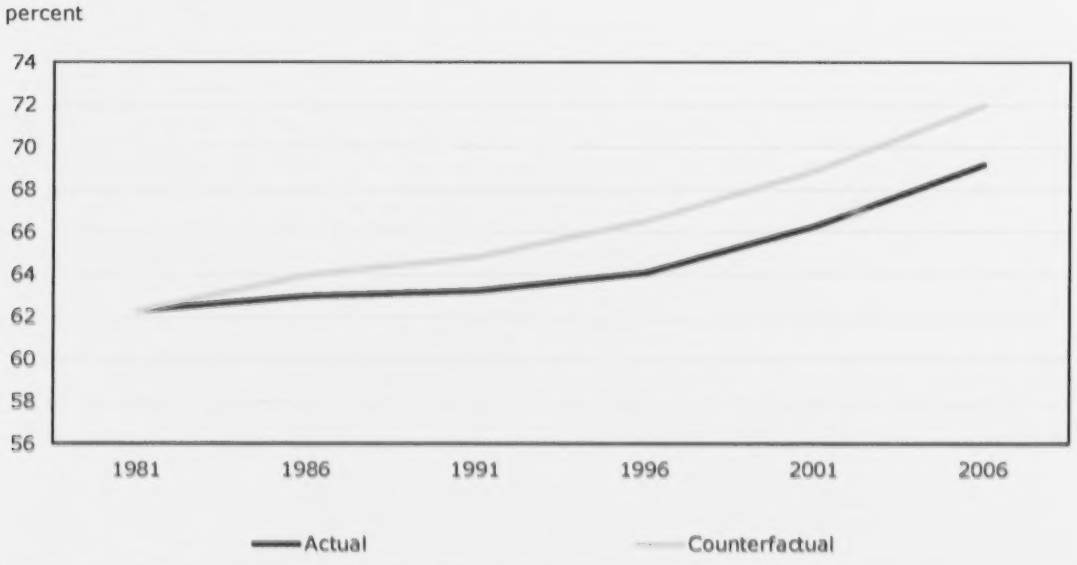
Source: Statistics Canada, Census of Population, 1981 to 2006.

There are two conclusions to be drawn from Chart 1. First, changes in family structure significantly affected homeownership rates between 1981 and 1996. While reported homeownership rates, as noted above, increased by about 2 percentage points over this period, homeownership would have increased by 4 percentage points if family structure had remained unchanged. Second, after 1996,

changes in family structure had little influence on homeownership, as the difference between the two curves remained largely unchanged. Hence, between 1981 and 1996, homeownership rates would have risen more quickly if family structure had not changed over the period. Throughout the period, after family structure is taken into account, it is observed that Canadian households increasingly chose to own, rather than rent, their dwelling.

Chart 1

Actual and counterfactual (after accounting for family structure) homeownership rates, 1981 to 2006

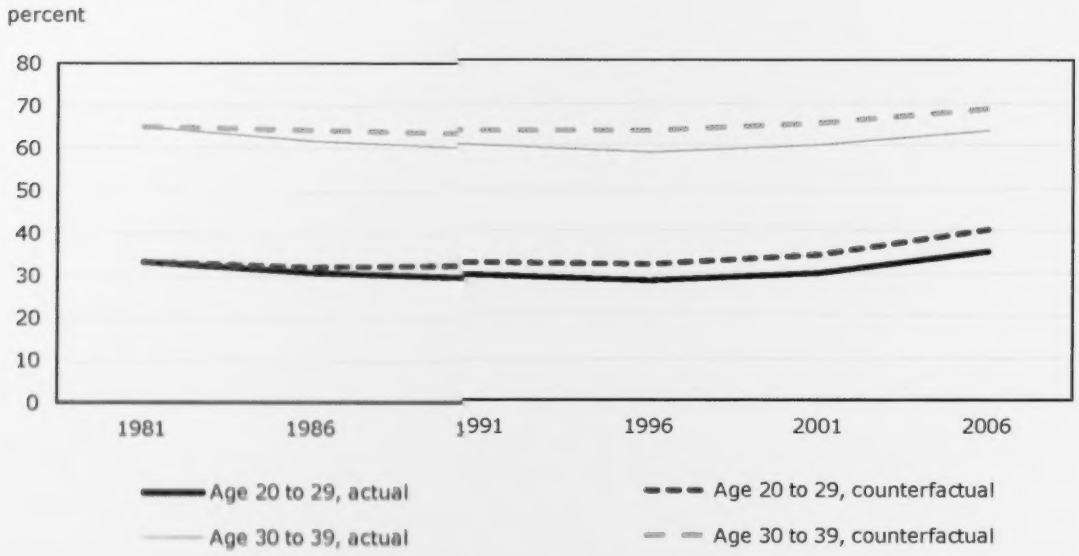


Source: Statistics Canada, Census of Population, 1981 to 2006.

Family structure had the greatest impact across the youngest age classes. Therefore, it is in these classes where trends in homeownership might be influenced the most by the changing economic conditions studied here. Chart 2 presents the actual and counterfactual rates of homeownership across the two youngest age classes. As with its effect on overall homeownership rates, controlling for family structure has a strong effect on rates over the 1981-to-1996 period. Much of the decline in rates of homeownership for these younger age classes is due to changing family structure. For instance, for the 30-to-39 age class, the actual rate of homeownership in 1996 was about 58%, while the counterfactual rate was 64%, which amounts to a 6-percentage-point difference.

Chart 2

Actual and counterfactual (after accounting for family structure) homeownership rates, by selected age classes, 1981 to 2006



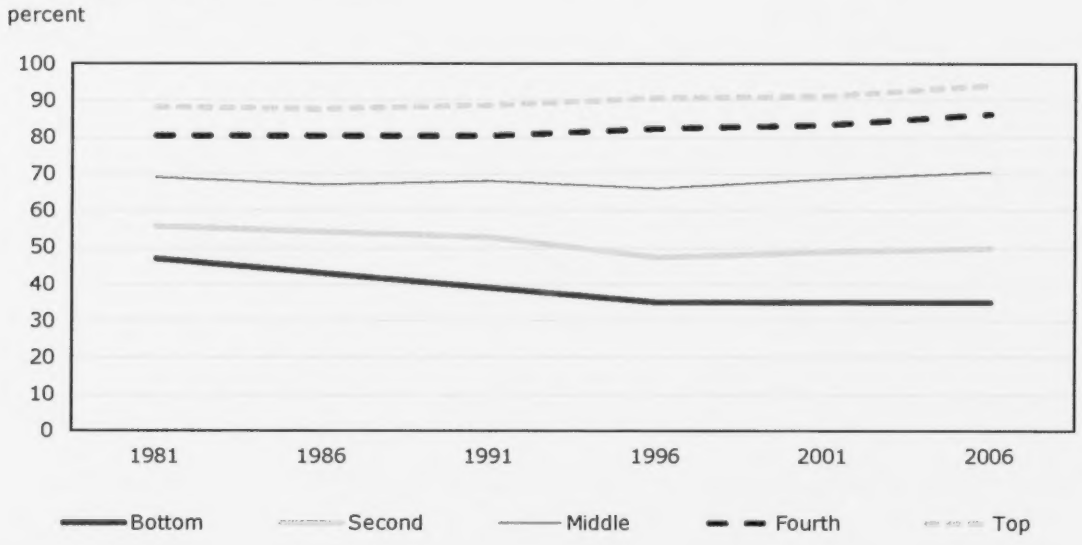
Source: Statistics Canada, Census of Population, 1981 to 2006.

While family structure accounts for the slower gains in homeownership early in the study period, it may not fully account for the differing trends across income quintiles. A direct way to explore this is to plot trends in homeownership across income quintiles by family type. These trends are presented, once again, for couples with children (Chart 3) and non-family individuals (Chart 4) in the two youngest household age classes.

Trends in the rate of homeownership varied considerably across income quintiles. For couples with children in the top income quintile, homeownership rates increased between 1981 and 2006, while homeownership rates fell for those in the bottom income quintile (see Chart 3). For non-family individuals, homeownership increased across all income classes (see Chart 4), but gains in homeownership were stronger in the top income quintiles, which was largely because of strong gains between 2001 and 2006. Lower gains were experienced in the lower-income classes.

Chart 3

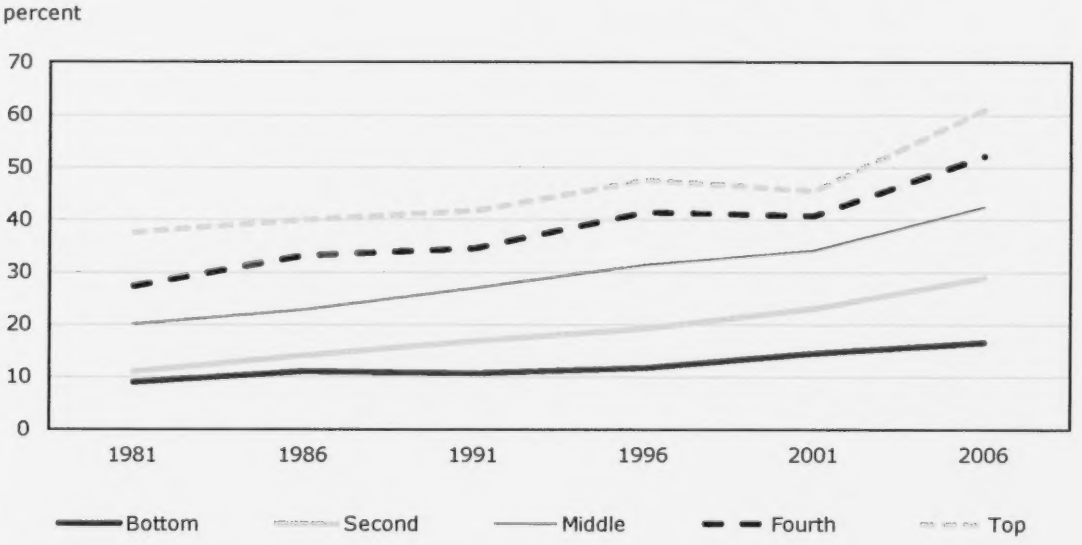
Homeownership rates for couples in the 20-to-39 age class with children, across income quintiles, 1981 to 2006



Source: Statistics Canada, Census of Population, 1981 to 2006.

Chart 4

Homeownership rates for non-family individuals in the 20-to-39 age class, across income quintiles, 1981 to 2006



Source: Statistics Canada, Census of Population, 1981 to 2006.

Overall, there was a trend towards increased homeownership between 1981 and 2006. Underneath this broad trend were significant changes in family structure that appeared to prevent homeownership rates from increasing even further. Yet, shifts in family structure cannot account for the contrasting trends in homeownership between lower-income and higher-income households. To build a better understanding of these trends, it is necessary, as a first step, to take into account those factors associated with the demand for owner-occupied housing—e.g., the cost of renting relative to owning, and household wealth—within a multivariate framework. The next section develops measures of these demand conditions, and the subsequent section presents estimates of their effect on the choice to own rather than rent.

4 Data and methodology

A household's decision to rent or own its home depends simultaneously on the relative merits of purchasing housing services through renting as opposed to supplying housing services to itself through home ownership and on expectations regarding returns to investing in housing relative to alternative investments.

The demand for owner-occupied housing is considered to be a function of household characteristics that influence the household's ability to purchase a home, the cost of renting relative to owning, and expected returns resulting from investing in a home. Household characteristics include household permanent income, household wealth, household family type, and employment of the primary maintainers. The cost of owner-occupied housing is measured by the cost of renting relative to owning an equivalent home. This is augmented by the carrying cost of the median-priced house in the household's region in a given year as a percentage of household income, which is commonly interpreted as a measure of affordability. Region is defined as the census metropolitan area/census agglomeration (CMA/CA) of the household or, if the household is located in a non-metropolitan area, the metropolitan influence zone (MIZ) of the household. Expected returns from investing in a home are measured by using the change in the mean value-to-rent ratio for a given region over the subsequent five years. By construction, this variable implicitly assumes that households in the current census year are able to anticipate house price appreciation, which, in turn, is reflected in the subsequent change in the value-to-rent ratio.[6]

The main data source for this paper is the Census of Population (1981 to 2006), which contains detailed information on the characteristics of households, housing tenure, rents and house values, and the geographic location of the household. The Census is augmented further by information from the Survey of Financial Security (1999 and 2005), which provides information on household wealth. This information is used to impute the financial capacity of households to meet minimum down payment requirements imposed by financial institutions in order to obtain a mortgage.

The goal of the analysis is to assess the factors that affect the probability of owning a home across income and age classes over the 1981-to-2006 period. Can the broad trends in homeownership—rising rates of homeownership among higher-income households and flat to falling rates of homeownership among lower-income households—be accounted for by changes in the underlying characteristics of households measured here? To answer this question, the probability of owning is estimated. This probability is taken to be a function of several underlying characteristics of the household and the housing market:

6. The level of the price-to-rent ratio is not used because, by construction, it will be highly correlated with the relative cost of renting versus owning.

$$\Pr(Own)_j^{a,q} = f\begin{pmatrix} Market\ Conditions_j, Financial\ Conditions_j, Connection\ to\ Labour\ Market_j, \\ Type_j^{fam}, Age_j^{head}, AgeSquared_j^{head}, Immigrant_j^{head}, Year \end{pmatrix}, \quad (3)$$

where Pr*(Own)* refers to the probability of homeownership for household j falling into age class a and income quintile q. $Market\ Conditions_j$ is a set of variables related to the costs of owning and renting a home. These include the following: relative cost, which is the annual cost of renting a dwelling divided by the annual cost of owning an equivalent dwelling; relative price change, which is the year-to-year percent change in the ratio of annual median house price to the median rental price of the household's region;[7] and the carrying-cost-to-income ratio, which is the household's carrying cost of a mortgage, based on the median house price of the household's region, as a percentage of its income.

The carrying cost of a mortgage is calculated as follows: $CarryingCost = MonthCost * (MedianHousePrice - (MedianHousePrice * 0.20))$. This cost is calculated assuming 20% housing equity. $MonthCost$ is the monthly mortgage cost for borrowing one dollar and is estimated as follows: $MonthCost = \left\{(rate_t / 12) / \left[1 - (1 + rate_t / 12)^{-300}\right]\right\}$, where $rate_t$ is the five-year fixed mortgage lending rate. It is assumed that payments are made on a monthly basis and that the mortgage is amortized over a 25-year period. The five-year fixed mortgage rate is obtained from the Bank of Canada series of historical mortgage rates (Bank of Canada 2010).

$Financial\ Conditions_j$ is a set of variables related to the household's financial capabilities. These include permanent income, wealth, and the ratio of transitory to permanent income. $Connection\ to\ Labour\ Market_j$ represents the number of hours worked per week and the number of weeks worked in the year prior to the Census, for the household head and his/her spouse (if applicable). Age_j^{head} and $AgeSquared_j^{head}$ are the age of the head of the household and its squared value, respectively. $Type_j^{fam}$ is the family type, which uses the same categories employed in the previous section. $Immigrant_j^{head}$ represents the immigration status of the household head. Finally, $Year$ is the census year. The measurement of the relative cost of owning, permanent income, and household wealth is explained below.

4.1 The cost of renting relative to owning

In order to estimate the cost of renting relative to owning a home, it is necessary to do so across comparable dwellings. Rental homes can differ markedly from owner-occupied homes in terms of their age, size, type of dwelling, and relative location. Our objective is to compare the cost of housing services for equivalent owner-occupied and rental dwellings. Such a comparison can be accomplished in several ways, including cross-tabulating owner-occupied and rental dwellings into similar groups or estimating hedonic regressions to generate imputed rents for owner-occupied dwellings. An alternative to these methods is propensity score matching (PSM), which matches

7. For a given census year, the change in the relative price-to-rent ratio is measured by using the percentage change in its value over the subsequent five years. As its value is not available for 2011, the percent change in the ratio for 2006 is estimated by means of an autoregressive model, which is a function of the percent change between 2001 and 2006.

owners to renters of similar homes and renters to owners of similar homes. This method is applied here and is discussed in detail in the Appendix.

Before the PSM model is used, the cost of owning or renting a home needs to be estimated. For renters, this is simply equal to the annual cost of renting the home. Following the methodology employed in Brown *et al.* (2010), the cost of owning a home (or the value of housing services) is measured by means of the user-cost-of-capital approach. As above, and repeated here for convenience, this is estimated by:

$$C_t = (r_t - a_t + z_t) P_t = R_t, \tag{4}$$

where: r is the rate of return to capital; P is the price of the dwelling; z is the rate of depreciation, maintenance, insurance, and property taxes; and a is the expected rate appreciation in the value of the dwelling in year t. R is the rental rate for the dwelling. The out-of-pocket costs, z, are estimated by using the same methodology employed in Brown and Lafrance (2010). The remaining user cost component, $r_t - a_t$, is the key component that needs to be estimated.

In Brown and Lafrance (2010), $r_t - a_t$ is calculated by taking advantage of the theoretical relationship between user costs and rents. That is, solving (4) for $r_t - a_t$ results in:

$$r_t - a_t = \frac{R_t}{P_t} - z_t. \tag{5}$$

Using information from both user costs and rents provides an alternative, and potentially more accurate, means to estimate $r_t - a_t$. Both terms might alternatively be estimated by obtaining measures of returns to capital (e.g., mortgage rates) and expected appreciation in house prices.

In Brown *et al.* (2010), rents and user costs were found to equate at the middle-house-value quintile. Hence, $r_t - a_t$ was estimated by using average imputed rents, prices, and other expenses (z) for owner-occupied dwellings that fall in the middle quintile. The average $r_t - a_t$ derived from Brown and Lafrance (2010), 0.9%, is used to estimate user costs across all years. This allows for user costs to diverge from rents over time, which would not be the case if user costs were estimated based on $r_t - a_t$ calculated every year.

Using the mean value of $r_t - a_t$ does have the drawback that real changes in the relative value of r and a over time will not be reflected in user costs. This may be important at the end of the period, when rising expectations regarding gains in house prices may have driven down $r_t - a_t$. To address this problem, the cost of renting relative to owning was estimated by using the time-varying estimate of $r_t - a_t$ for 2006. This resulted in no qualitative change in the estimates.

The cost of renting, relative to owning, a home is determined in this paper for each household by using only the matched data, created through the use of the PSM model (see Appendix). The average ratio of the cost of renting to owning a dwelling for all households is illustrated in Chart 5. On average, between 1981 and 2006, it was more expensive to rent than to own an equivalent home. The incentive to own a home increased between 1981 and 2001—the ratio of the cost of

renting to owning rose from 1.32 in 1981 to 1.61 in 2001. In contrast, there was a steep drop in the cost of renting relative to owning between 2001 and 2006, which stemmed from a rapid rise in the price of dwellings (Brown *et al.* 2010) that drove up user costs.

It should be kept in mind that, while it costs more to rent than to own the equivalent home over the period, this does not necessarily mean that it is always optimal to own rather than rent. For instance, the measure of user costs employed here does not incorporate transaction costs.[8] Amortized over a long period of time, these are relatively small. However, for households that expect to move more often (e.g., younger households), transaction costs may make a substantial annualized contribution to the overall cost of owning, and this may make renting a lower-cost option.

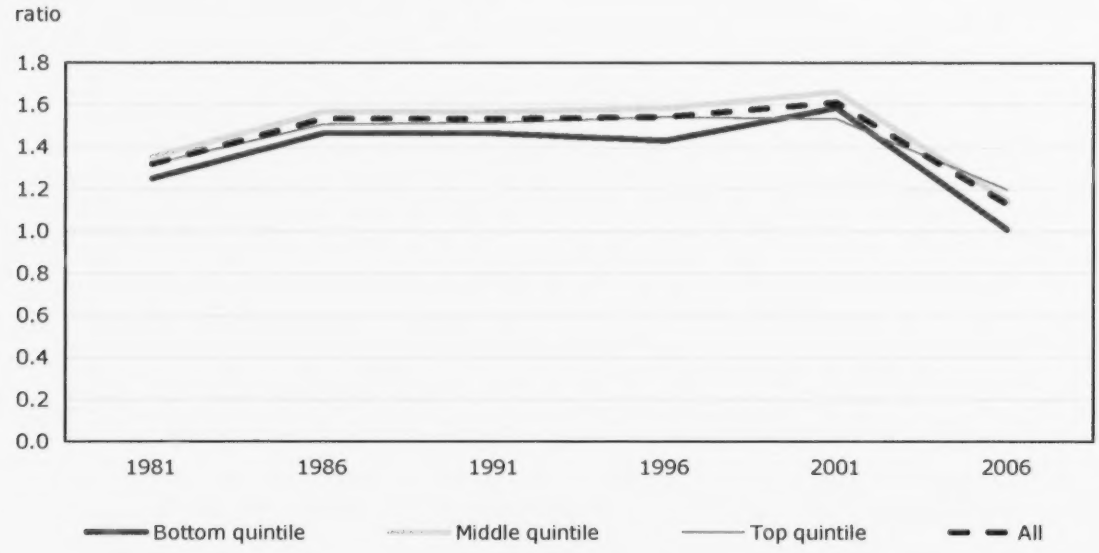
One of the primary objectives of this study is to develop a better understanding of the trends in homeownership across income quintiles. Part of the difference in homeownership rates that are observed across these groups may be attributed to the cost of renting relative to owning. That is, it may be more expensive for higher-income households than for lower-income households to rent an equivalent dwelling (e.g., because rental markets are thin for these types of homes).

Chart 5 also presents the cost of renting relative to owning a home across income quintiles. The cost of renting is almost always less for households in the lowest income quintile than for households in the middle and top income quintiles; this is consistent with households in the lowest income quintile favouring renting over owning. However, for households in the middle quintile, renting tends to be the most expensive option, while households in the top income quintile, which are the most likely to own, fall in between the bottom and middle quintiles in this respect. While the relative cost of renting across quintiles does not follow a consistent pattern, as will become apparent below, once households are divided further by age and household type, a much clearer relationship emerges.

8. These costs can be substantial. Real estate fees and closing costs can amount to as much as 7% of the value of the home. If a household stays in a home for five years, this amounts to an annual cost of $5,600 for a home valued at $400,000 when sold.

Chart 5

Ratio of the cost of renting to owning an equivalent dwelling for all households, by selected income quintiles, 1981 to 2006



Source: Statistics Canada, Census of Population, 1981 to 2006.

Table 3 presents the relative cost of renting for younger households (aged 20 to 39)—amongst these, households consisting of couples with children and households consisting of non-family individuals—across income quintiles. For younger households in total, Table 3 clearly shows a positive association between income and the relative cost of renting. This table also shows that, until 2001, these costs increased across all income classes. However, this broad association masks very different underlying relationships between the relative cost of renting and incomes by family type.

For young couples with children, the relationship is reversed from that for the overall population of households (see Table 3). Throughout most of the period, renting was more expensive for low-income households and cheaper for higher-income households, creating a greater incentive for low-income households to own. This runs counter, however, to the behaviour of young couples with children, where lower-income households have increasingly chosen to rent over the period, while higher-income households have increasingly chosen to own.

On the other hand, for young non-family individuals, there is a strong positive association between income and the relative cost of renting. Moreover, for these households, there was a strong upward move in the relative cost of renting, particularly between 1996 and 2001. It is, therefore, not surprising that these households increasingly chose to own rather than rent over the period, particularly the higher-income households in this group. For higher-income households, there appears to be a relatively stronger incentive to own throughout the period.

Table 3

Ratio of the cost of renting to owning an equivalent dwelling for households aged 20 to 39, by selected family type, across selected income quintiles, 1981 to 2006

	1981	1986	1991	1996	2001	2006
			ratio			
All households						
Bottom quintile	1.3	1.5	1.4	1.4	1.6	1.0
Middle quintile	1.4	1.6	1.6	1.6	1.8	1.1
Top quintile	1.4	1.6	1.6	1.6	1.7	1.2
Couples with children						
Bottom quintile	1.5	1.7	1.7	1.6	1.7	1.1
Middle quintile	1.4	1.6	1.6	1.7	1.7	1.2
Top quintile	1.3	1.5	1.5	1.6	1.6	1.2
Non-family individuals						
Bottom quintile	1.1	1.3	1.3	1.3	1.6	0.9
Middle quintile	1.4	1.6	1.6	1.6	2.0	1.1
Top quintile	1.6	1.9	1.7	1.8	1.9	1.2

Source: Statistics Canada, Census of Population, 1981 to 2006.

There are two additional points to be drawn from the trends in the cost of renting relative to owning. First, the rising relative cost of renting coincided with the general increase in the rate of homeownership. This suggests that renters were reacting to changes in the cost of renting relative to owning. The exception was the end of the period, when declining relative rental costs were not accompanied by declining rates of homeownership, which may reflect a surge in homeownership early in the 2001-to-2006 period, when the cost of renting was still relatively high. Second, the cost of renting increased with household income, particularly for young non-family individuals. This suggests that, as incomes rise, rental accommodation is less and less a substitute for owner-occupied housing. This is a point that will be echoed in the econometric analysis shown below.

4.2 Permanent income

Rather than use current income, it is more appropriate to use a measure of permanent income when modelling the decision to own or to rent a home. A household's decision to invest in a home will depend not only on the household's current income, but also on potential lifetime earnings. Lifetime earnings are unobservable and, as such, have to be estimated.

In traditional human capital models, income is expressed as a function of permanent and transitory income:

$$Y = Y^P + Y^T, \tag{6}$$

where: Y is current income; Y^P is permanent income; and Y^T is transitory income.[9] Y^P is the fitted value of the regression while Y^T is the residual term. Since Y^P is not observed, it is estimated as a function of human capital (e.g., education, age, and labour force status) and other assets. Following Goodman (1988) and Dusansky and Koç (2007), a hedonic regression for permanent income is estimated by using the following specification:

9. Goodman (1988) and Dusansky and Koç (2007) included transitory income in their final housing demand model. This approach will not be followed here as including this residual term does not seem appropriate in this context.

$$\hat{Y}^P = \alpha + \boldsymbol{\beta}'\mathbf{HC}_i + \boldsymbol{\gamma}'\mathbf{NonHC}_i, \quad (7)$$

where: $\mathbf{HC}_i$ is a set of human capital characteristics for individual i, including highest level of educational attainment, age, and whether the individual is employed or not; and $\mathbf{NonHC}_i$ is a set of other characteristics that may have an impact on the individual's permanent income, including sex, marital status, occupation, whether the individual lives in a CMA/CA or a rural region, and immigration status. The fitted values for $\hat{Y}^P$ are summed up to the household level.

4.3 Wealth

Permanent income does not directly account for financial assets, which, when applying for a mortgage, will have an impact on the size of the loan, and, therefore, on the likelihood that the loan will be approved. Thus, it is important to consider household wealth along with permanent income.

Because the Census of Population does not contain any information on assets and debts, information from the 1999 and 2005 Survey of Financial Security (SFS) is used to generate a measure of wealth. Wealth (or liquid wealth) is defined as the sum of non-pension financial assets, retirement funds, and business equity. Because these variables are not available in the Census, other variables available in both datasets must be used to estimate wealth. The impact of household wealth is modelled here as the probability of wealth being greater than 20% of the average house value[10] in a given year:

$$\Pr(A = 1) = f\left(Age_i, InvInc_i, University_i, Immigrant_i\right), \quad (8)$$

where: Age_i is individual i's age (a term for age squared is also included); $InvInc_i$ is investment income; $University_i$ is equal to '1' if individual i has a university degree or higher; and $Immigrant_i$ is equal to '1' if individual i is an immigrant. Also included is a binary variable to indicate whether the individual has negative investment income, which may be due to negative returns. Equation (8) is estimated by using the 1999 and 2005 SFS. The coefficient estimates are presented in Table 4.

10. Following Bourassa and Hoesli (2010), we assume that the household's wealth constraint requires a minimum 20% of the value of the house in equity.

Table 4
The probability of an individual having adequate wealth to purchase a home, 1999 and 2005

	1999		2005	
	coefficient	p-value	coefficient	p-value
Constant	-5.9103	0.000	-6.3429	0.000
Age	0.2396	0.000	0.2399	0.000
Age squared	-0.0021	0.000	-0.0019	0.000
University	1.0226	0.000	0.6855	0.000
Immigrant	-0.5708	0.000	-0.9337	0.000
Investment income	0.9007	0.000	1.0590	0.000
Investment income (1 if investment income is less than 0)	-0.8671	0.000	-1.2499	0.034
Negative investment income	-0.0001	0.235	-0.0004	0.062
	1999		2005	
Number of observations	5,130		1,781	
R-squared	0.1120		0.1397	
Log pseudo likelihood	-2,233,154		-2,583,770	

Source: Statistics Canada, Survey of Financial Security (1999 and 2005).

The probability of having adequate wealth to finance the purchase of a home increases with age and investment income. Individuals with a university degree are more likely to have adequate wealth, while immigrants may be less likely to have adequate wealth. From 1999 to 2005, there is no qualitative change in the coefficients, although having a university degree appears to be slightly less important in 2005 than in 1999.

To apply the estimates to the Census, the estimated coefficients from the 2005 SFS are applied to the 2006 Census data in order to derive a predicted probability of having liquid wealth. Because there is relatively little variation in the estimated coefficients over time (see Table 4), coefficients from the 1999 SFS are applied to all other Census years (i.e., 1981 to 2001). From these predictions a wealth indicator variable is created. If the predicted probability is greater than 0.5, the household is assumed to have adequate liquid wealth to finance the purchase of a home (wealth = 1).[11]

Of course, with Canada Mortgage and Housing Corporation (CMHC) insurance, households may be able to obtain a mortgage even when their level of wealth is less than that necessary for a 20% down payment. This level is chosen, however, for two reasons. First, it is the point at which households do not have to pay CMHC mortgage insurance. Therefore, above this level of down payment, households have a stronger incentive to invest in a home. Second, it is unlikely that households would liquidate all of their wealth for a down payment. This level of wealth is, therefore, simply a reasonable point at which it would be anticipated that households would have sufficient wealth to meet CMHC guidelines while also keeping some wealth invested in other assets.

4.4 Descriptive statistics

Summary statistics for all of the explanatory variables, tabulated by tenure and year for all age classes and for younger households are contained in Table 5. Of particular interest is the evolution in the characteristics of renters. Have their characteristics evolved in such a way that the latent potential for homeownership has been rising or declining over time?

11. When the model was applied to the SFS, 74% of the observations were accurately predicted.

On the one hand, in the 20-year period between 1981 and 2001, wealth and the relative cost of renting increased for renters. This suggests that renters were in a better position to transition from renting to owning by 2001, and had a rising incentive to do so. On the other hand, the other variables suggest some diminution in the position of renters during this period—their mortgage-carrying-cost-to-income ratio fell only modestly, and hours worked per week also declined. Nevertheless, renters appeared by 2001 to be in a relatively good position to make the transition from renting to owning. This conclusion is reinforced by the fact that 2001 was the only instance where the relative cost of renting was higher for renters than homeowners.

Between 2001 and 2006, a significant transformation took place in the underlying characteristics of renters (and homeowners). This was a period of rising house prices, which is reflected in those variables that incorporate house prices into their construction. The proportion of renters with sufficient wealth to make a 20% down payment falls, particularly for younger households. Despite rising prices, the mortgage-carrying-cost-to-income ratio remains quite steady. The relative cost of renting falls from well above 1 to less than 1. Therefore, over much of the period, the underlying fundamentals tilt increasingly towards home owning, but reverse by the end as house prices increase between 2001 and 2006. Yet, this was the period in which homeownership rose the most. To assess the independent effect of these variables on the probability of owning a home, it is necessary to move to a multivariate econometric analysis, which is taken up in the next section.

Table 5
Summary statistics for selected explanatory variables by tenure and household age class, 1981 to 2006 — Part 1

	Household financial condition		Market conditions		
	Permanent income	Wealth [1]	Mortgage-carrying cost to income	Relative cost of renting to owning	Change in the relative price-to-rent ratio [2]
	dollars	percent	ratio		percent
All age classes					
Homeowners					
1981	64,273	76	0.82	1.37	-5
1986	68,373	79	0.48	1.57	18
1991	73,754	81	0.97	1.58	-2
1996	74,742	82	0.40	1.60	4
2001	79,610	84	0.37	1.57	15
2006	81,259	83	0.44	1.22	27
Renters					
1981	42,859	51	1.86	1.25	-6
1986	43,331	53	1.11	1.47	15
1991	46,537	55	2.47	1.45	-5
1996	44,740	57	1.33	1.45	2
2001	49,636	62	1.21	1.70	13
2006	49,425	59	1.19	0.94	24
Age 20 to 39					
Homeowners					
1981	67,830	42	0.68	1.43	-4
1986	72,157	45	0.38	1.64	18
1991	76,541	47	0.99	1.65	-1
1996	77,762	46	0.38	1.68	4
2001	84,414	47	0.38	1.66	16
2006	87,058	39	0.48	1.23	27
Renters					
1981	46,522	22	1.81	1.30	-5
1986	46,106	24	1.08	1.50	17
1991	48,663	27	2.57	1.49	-4
1996	45,789	27	1.28	1.46	3
2001	52,319	29	1.21	1.77	14
2006	53,234	18	1.29	0.96	25

1. Share of households with sufficient wealth for a 20% down payment on a median-priced home in their geographic area.
2. Change in the price-to-rent ratio between census years applied to the start of the period.
Sources: Statistics Canada, Census of Population (1981 to 2006) and Survey of Financial Security (1999 and 2005).

Table 6

Summary statistics for selected explanatory variables by tenure and household age class, 1981 to 2006 — Part 2

	Connection to labour market				Household type [1]		Immigrant status [1]
	Hours worked per week		Weeks worked per year		Couples with children	Non-family individual	
	Head	Spouse	Head	Spouse			
	number				percent		
All age classes							
Homeowners							
1981	31	16	38	23	58	11	23
1986	30	17	36	25	54	13	20
1991	29	20	36	29	51	14	21
1996	29	21	35	30	48	15	21
2001	29	22	36	31	45	16	22
2006	30	23	37	32	42	18	23
Renters							
1981	28	17	34	23	25	40	18
1986	26	17	32	24	24	41	16
1991	25	17	32	26	22	43	18
1996	23	19	29	25	22	44	20
2001	25	19	31	25	20	45	21
2006	26	19	32	25	18	47	22
Age 20 to 39							
Homeowners							
1981	39	18	46	27	72	7	18
1986	39	21	45	30	69	9	13
1991	38	23	46	35	66	11	13
1996	38	27	45	36	63	13	12
2001	39	28	46	39	59	15	14
2006	38	29	45	39	54	18	16
Renters							
1981	33	20	33	27	28	38	15
1986	31	21	37	28	27	38	12
1991	30	20	37	30	25	40	14
1996	28	22	34	29	25	41	17
2001	30	22	37	29	23	42	18
2006	31	22	37	29	21	45	19

1. Measured as a share of all households in an age-tenure class.
Sources: Statistics Canada, Census of Population (1981 to 2006) and Survey of Financial Security (1999 and 2005).

5 Econometric results

To establish the relationships between the posited correlates and tenure choice, estimates for the entire sample are presented in the first stage of the analysis. Following this, the analysis concentrates on the two household types—young couples with children and young non-family

individuals—that experienced divergent trends, particularly when these households were subdivided into income quintiles. The issue is whether the covariates apply equally across these groups and whether they are able to account for their divergent trends.

The marginal effects of the correlates on the probability of owning a home for the full set of households are presented in Table 7.[12] Model 1 includes only a set of binary variables for each year, the excluded year being 1981. With the exception of 1986, there is a general increase in the odds of owning throughout the period, which is consistent with the trend observed in actual rates of homeownership. Homeownership increases slowly until 1996 and accelerates afterwards. The drop in the odds of owning in 1986 stems from using a more restricted sample for the estimates.[13]

In Model 2 of Table 7, the full set of correlates is added to the year binary variables. As expected, households are more likely to own when the relative cost of renting increases. A one-standard deviation change in the cost of renting relative to owning increases the probability of owning a home by 4.4%. Households are less likely to own when the carrying cost of a mortgage relative to their incomes is higher. Households are also more likely to own when the price-to-rent ratio is higher, suggesting that households are more likely to buy when there are rising expectations of house price appreciation.

The financial condition of the household is also associated with the choice to own. Those households with higher permanent incomes and sufficient wealth for a 20% down payment on a median-priced home are more likely to own. The connection of the household to the labour market, measured through hours and weeks worked, also had the expected effect. Household head weeks and hours worked have a positive effect, while spousal hours and weeks worked have a generally positive effect for couples with children and a mixed effect for couples without children.

Finally, the results for family type and age of the household head are in line with expectations. Compared to couples with children, all other family types were less likely to own. Non-family individuals were 32% less likely to own than couples with children. Households headed by older persons were more likely to own, but this positive effect declined with the age of the household head. Immigrants were also less likely to own than those who were Canadian-born, by a factor of 4.6%.

12. As the tenure choice of households was regressed against independent variables aggregated to the regional level, the standard errors were initially adjusted for the potential correlation of errors within regions. However, because there was no qualitative change in the standard errors, the econometric results are presented without this adjustment.
13. The sample is restricted to households for which the cost of renting relative to owning an equivalent home is greater than 0.5 and less than 4. The sample is restricted in this way in order to minimize the effect of measurement error on the estimates. Exploration of the micro data suggested that very low or very high relative costs were the result of errors on the file regarding rental rates, rather than genuine differences in the cost of renting relative to owning.

Table 7
Marginal effects of logit estimates of households owning a home

	All households		Households aged 20 to 39	
	coefficient	p-value	coefficient	p-value
Model 1				
Year binary variables				
1986	-0.006	0.000	-0.025	0.000
1991	0.001	0.449	-0.023	0.000
1996	0.003	0.000	-0.031	0.000
2001	0.013	0.000	-0.031	0.000
2006	0.056	0.000	0.016	0.000
Model 2				
Year binary variables				
1986	-0.047	0.000	-0.065	0.000
1991	-0.028	0.003	-0.054	0.000
1996	-0.034	0.000	-0.065	0.000
2001	-0.045	0.000	-0.059	0.000
2006	-0.001	0.968	0.030	0.092
Market conditions				
Relative cost (renting to owning)	0.044	0.000	0.052	0.000
Relative price (price to rent)	0.025	0.075	0.017	0.163
Mortgage-carrying cost to income	-0.000005	0.140	-0.000004	0.469
Financial conditions				
Permanent income	0.080	0.000	0.090	0.000
Wealth	0.034	0.000	0.041	0.000
Connection to the labour market				
Household head hours worked	0.001	0.000	0.001	0.000
Household head weeks worked	0.002	0.000	0.004	0.000
Spouse hours worked × couples with children	-0.0001	0.433	0.0002	0.057
Spouse weeks worked × couples with children	0.002	0.000	0.003	0.000
Spouse hours worked × couples with no children	-0.001	0.000	0.000	0.617
Spouse weeks worked × couples with no children	0.001	0.000	0.003	0.000
Family type				
Couple with no children	-0.089	0.000	-0.211	0.000
Male lone parent	-0.210	0.000	-0.171	0.000
Female lone parent	-0.262	0.000	-0.275	0.000
Non-family individual	-0.315	0.000	-0.329	0.000
Age of the household head				
Age of the household head	0.021	0.000	0.096	0.000
Age squared	-0.0001	0.000	-0.001	0.000
Immigrant status	-0.046	0.000	-0.110	0.000

	All households	Households aged 20 to 39
Number of observations	4,241,085	1,571,324
Model 1		
Pseudo *R-squared*	0.002	0.001
Wald chi-square	7,411	1,530
Log pseudo likelihood	-13,714,145	-5,517,573
Model 2		
Pseudo *R-squared*	0.217	0.236
Wald chi-square	121,258	71,718
Log pseudo likelihood	-10,759,948	-4,220,307

Notes: The market condition variables and financial condition variables (except wealth) have all been normalized by the standard deviation of the variable across the sample (except for the mortgage-carrying-cost-to-income ratio, which excludes the top and bottom 5% of households based on household income). The coefficients measure the change in the dependent variable resulting from a one-standard-deviation change in the independent variable.

Sources: Statistics Canada, Census of Population (1981 to 2006) and Survey of Financial Security (1999 and 2005).

With the inclusion of binary variables to account for wealth and family type, the excluded category is households with children without sufficient wealth for a standard down payment. The trend in homeownership, after the full set of correlates are taken into account, is a decline between 1981 and 1986 followed by a rise in homeownership between 2001 and 2006.

It is generally between the ages of 20 and 39 that most households make the transition from renting to owning. Therefore, this group is the most likely to react to changing incentives. When the sample is restricted to these younger working-age households, the overall trend in homeownership is quite different (see Table 7, households aged 20 to 39, Model 1). Contrary to the results for the general population, the propensity to own among this group drops between 1981 and 1986 and does not recover until 2006. This is a pattern that holds after housing market conditions, the financial conditions of households, and the connection of households to the labour market are taken into account. There is an apparent structural break between 1981 and 1986 that reduced the propensity for younger households to own. This reduction in the propensity persisted for at least 15 years. It was not until 2006 that homeownership rates recovered.

At issue are the trends in homeownership across the income distribution. Table 8 and Table 10 present estimates for young couples with children and for young non-family individuals, respectively, by income quintile. These are the family types for which trends in homeownership across the income quintiles differed markedly (see Chart 3 and Chart 4). Isolating these households allows us to ask whether rising relative rates of homeownership amongst higher-income households can be accounted for by the shifting housing market and household financial conditions.

In order to trace out the trends in homeownership between 1981 and 2006, a model with only the year binary variables is presented first (Table 8, Model 1). As expected, these trends match those presented in Chart 3. Lower-income couples with children became less likely to own over time, while higher-income couples became more likely to own, particularly in 2006.

Of interest is whether the trend in homeownership can be accounted for by the inclusion of variables expected to affect tenure choice (Table 8, Model 2). However, before addressing this question directly, it is useful to revisit the correlates, because the point estimates do vary qualitatively across the income quintiles.

Table 8

Marginal effects of the odds of owning a home, couples aged 20 to 39 with children

	Income quintile					
	Bottom		Middle		Top	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
Model 1						
Year binary variables						
1986	-0.047	0.000	-0.029	0.000	0.001	0.578
1991	-0.076	0.000	-0.012	0.000	0.007	0.004
1996	-0.120	0.000	-0.038	0.000	0.025	0.000
2001	-0.128	0.000	-0.024	0.000	0.025	0.000
2006	-0.111	0.000	-0.003	0.434	0.052	0.000
Model 2						
Year binary variables						
1986	-0.053	0.000	-0.183	0.000	-0.040	0.000
1991	-0.117	0.000	-0.140	0.000	-0.018	0.102
1996	-0.151	0.000	-0.219	0.000	-0.018	0.053
2001	-0.151	0.000	-0.233	0.000	-0.028	0.005
2006	-0.099	0.000	-0.211	0.000	-0.002	0.894
Market conditions						
Relative cost (renting to owning)	0.071	0.000	0.027	0.023	-0.012	0.005
Relative price (price to rent)	-0.016	0.330	0.014	0.204	0.009	0.001
Mortgage-carrying cost to income	0.000002	0.923	-0.156	0.000	-0.050	0.000
Financial conditions						
Permanent income	0.013	0.466	0.081	0.000	0.019	0.000
Wealth	0.037	0.000	0.024	0.000	0.016	0.000
Transitory to permanent income	-0.289	0.000	0.122	0.000	0.005	0.136
Connection to the labour market						
Household head hours worked	0.002	0.000	0.001	0.000	-0.00004	0.548
Household head weeks worked	0.004	0.000	0.001	0.000	0.001	0.000
Spouse hours worked	0.001	0.000	0.0002	0.101	-0.00001	0.809
Spouse weeks worked	0.003	0.000	0.001	0.000	0.001	0.000
Age of the household head						
Age of the household head	0.110	0.000	0.100	0.000	0.039	0.000
Age squared	-0.001	0.000	-0.001	0.000	-0.0005	0.000
Immigrant status	-0.178	0.000	-0.060	0.000	-0.021	0.000

	Income quintile		
	Bottom	Middle	Top
Number of observations	60,569	188,767	150,880
Model 1			
Pseudo *R-squared*	0.007	0.001	0.007
Wald chi-square	511.580	140.590	521.770
Log pseudo likelihood	-192,383	-580,854	-242,938
Model 2			
Pseudo *R-squared*	0.152	0.064	0.053
Wald chi-square	5,223	11,325	4,409
Log pseudo likelihood	-164,404	-544,107	-231,682

Notes: The market condition variables and financial condition variables (except wealth) have all been normalized by the standard deviation of the variable across the sample (except for the mortgage-carrying-cost-to-income ratio, which excludes the top and bottom 5% of households based on household income). The coefficients measure the change in the dependent variable resulting from a one-standard-deviation change in the independent variable.

Sources: Statistics Canada, Census of Population (1981 to 2006) and Survey of Financial Security (1999 and 2005).

Beginning with housing market conditions, the relative cost of renting has a positive effect on homeownership for households in the bottom quintile, but the point estimate falls with income, such that, for the top income quintile, its estimated effect is negative. This is highly suggestive that owner-occupied and rental dwellings are substitutes for lower-income households but not for higher-income households; that is, there is no reasonable expectation of arbitrage between renting and owner-occupying for higher-income households. The change in the house price-to-rent ratio generally has the expected positive sign, but its marginal effect is modest and statistically significant only for those in the top income quintile. Finally, households with higher mortgage-carrying-costs-to-income ratios were less likely to own, but this effect holds only for middle- and top-income households. For lower-income households, the coefficient is insignificant. This is at first glance unexpected, because it would be reasonable to expect lower-income households to be particularly sensitive to mortgage-carrying costs. However, if lower-income homeowners were less likely to participate in the mortgage market, this result would be more understandable. This is this case. Across young lower-income homeowners, the average equity share and proportion of households without a first mortgage outstrip those of households in the middle and top income quintiles (see Table 9). These are households that have been able to save sufficient funds or have access to alternative pools of capital, which allow them to buy their homes outright or to have a substantial down payment that would minimize their monthly mortgage costs.

Table 9

Equity shares and proportion of households without a first mortgage, households aged 20 to 39, across selected income quintiles, 2005

Income quintile	Average equity share	No first mortgage
	percent	percent of households
Bottom	51	30
Middle	38	8
Top	47	7

Source: Statistics Canada, Survey of Financial Security (2005).

With respect to household financial conditions, permanent income had a positive effect on homeownership, particularly for households in the middle quintile.[14] Wealth has a positive but declining effect with income, a finding which suggests that the need for a down payment restricts all households, but the effect is indeed stronger for couples with children in the bottom income quintile. The effect of income uncertainty (transitory/permanent income) is negative and significant for lower-income households but positive and significant for households in the middle and top income quintiles. The effect of income uncertainty is expected to be negative, because it is expected to increase the option value of waiting to purchase a home. For lower-income households who have little cushion in their budget to absorb an income shock, the negative sign is consistent with expectations. The positive sign for middle-income households may reflect the positive association between uncertainty and savings, which, in turn, assists with the transition from renting to owning (Fisher and Gervais 2009).

Finally, households' connection to the labour market, measured by hours and weeks worked, had no economically meaningful effect on homeownership. Households' immigrant status, on the other hand, did have a strong association with probability of homeownership that decreases by income; that is, an immigrant in the lowest income quintile is 18% less likely to own a home than a non-

14. It may seem as though income is controlled for twice here, since the regressions are done across income quintiles and permanent income is included in the model. It should be kept in mind, however, that individuals' current income may differ from their permanent income, particularly for those in the bottom income quintile.

immigrant, while an immigrant in the highest income quintile is 2% less likely than a non-immigrant to own a home.

At issue is the degree to which the correlates account for trends in homeownership across income quintiles for young couples with children. The drop in homeownership rates post-1981 for households in the bottom income quintile remains after one takes the correlates into account. For households in the middle and upper income quintiles, the model reveals an apparent structural break between 1981 and 1986; that is, there is a drop in the propensity to own after 1981. Still, setting aside this downward shift, there is no apparent change in the trend in homeownership. For the middle and top income classes, the model does not as much account for their respective trends in homeownership as reveal an underlying shift that has made them less likely to own, all else being held equal. What underlies this shift is an issue to which the discussion will return.

For young non-family individuals (Table 10), the marginal effects are similar to those for couples with children, but there are exceptions. The change in the price-to-rent ratio has a stronger positive marginal effect, especially for households in the top income quintile. This is suggestive that expectations regarding capital gains have a stronger influence on the tenure choice of non-family individuals than on that of couples with children. The effect of permanent income is negative among non-family individuals—this is not the case for couples with children—and runs against expectations. Wealth has no significant association with homeownership.

The main difference between non-family individuals and couples with children is their trends in homeownership captured by the year binary variables. In contrast to the situation of couples with children, homeownership increased across all income classes. Yet, after taking into account market and household conditions, the structural break observed for couples with children is also present.

To this point, the structural break in the series between 1981 and 1986 that is present for both young couples with children and young non-family individuals has been left unaddressed. A possible cause of this break is the transfer of interest rate risk from lenders to borrowers that peaked in the early 1980s. Through the latter part of the 1960s and into the 1970s, rising interest rates exposed Canadian lenders to increasing interest rate risk. In response, they shortened mortgage terms from 25 years to 5 years and "...[b]y the beginning of the 1980s, loans with terms of more than three years were unavailable and some lenders restricted their menu of terms to one year or less." (Jones 1996, p. 91) This shift in interest rate risk from lenders to borrowers means that lower-income households, on whose budget a rise in mortgage payments would put severe constraints, would be more reluctant to take on a mortgage (Breslaw *et al.* 1996). While mortgage products have become less restrictive since the early 1980s, the run-ups in interest rates in the early 1980s and in the early 1990s may have resulted in higher expectations of the interest rate risk which have not diminished through time.

Table 10

Marginal effects of the probability of owning a home, non-family individuals aged 20 to 39, by selected income quintiles

	Bottom quintile		Middle quintile		Top quintile	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
Model 1						
Year binary variables						
1986	0.021	0.000	0.030	0.000	0.031	0.014
1991	0.026	0.000	0.085	0.000	0.070	0.000
1996	0.036	0.000	0.126	0.000	0.125	0.000
2001	0.064	0.000	0.146	0.000	0.076	0.000
2006	0.107	0.000	0.242	0.000	0.225	0.000
Model 2						
Year binary variables						
1986	0.004	0.733	-0.089	0.000	-0.131	0.000
1991	-0.003	0.740	-0.010	0.647	-0.005	0.898
1996	0.006	0.541	-0.012	0.634	-0.030	0.482
2001	0.025	0.063	-0.001	0.943	-0.108	0.008
2006	0.104	0.000	0.119	0.000	0.003	0.920
Market conditions						
Relative cost (renting to owning)	0.052	0.000	0.061	0.000	-0.010	0.325
Relative price (price to rent)	0.0004	0.963	0.028	0.014	0.057	0.000
Mortgage-carrying cost to income	0.000002	0.239	-0.086	0.002	-0.196	0.000
Financial conditions						
Permanent income	-0.005	0.210	-0.053	0.000	-0.027	0.001
Wealth	0.010	0.061	0.003	0.816	0.004	0.701
Transitory to permanent income	-0.045	0.001	0.034	0.003	0.010	0.442
Connection to the labour market						
Household head hours worked	0.001	0.000	0.001	0.000	0.001	0.000
Household head weeks worked	0.001	0.000	0.001	0.000	0.004	0.000
Age of the household head						
Age of the household head	0.021	0.000	0.071	0.000	0.068	0.000
Age squared	-0.0002	0.001	-0.001	0.000	-0.001	0.001
Immigrant status	-0.003	0.851	-0.011	0.403	0.009	0.643
	Bottom quintile		Middle quintile		Top quintile	
Number of observations	117,665		81,056		23,920	
Model 1						
Pseudo *R-squared*	0.009		0.019		0.014	
Wald chi-square	774		1,646		379	
Log pseudo likelihood	-247,755		-262,194		-87,491	
Model 2						
Pseudo *R-squared*	0.090		0.085		0.079	
Wald chi-square	5,109		6,662		3,802	
Log pseudo likelihood	-227,444		-244,558		-81,664	

Notes: The market condition variables and financial condition variables (except wealth) have all been normalized by the standard deviation of the variable across the sample (except for the mortgage-carrying-cost-to-income ratio, which excludes the top and bottom 5% of households based on household income). The coefficients measure the change in the dependent variable resulting from a one-standard-deviation change in the independent variable.

Sources: Statistics Canada, Census of Population (1981 to 2006) and Survey of Financial Security (1999 and 2005).

If rising interest rate risk, which had been effectively shifted from lenders to homeowners through shorter mortgage terms by 1981, underlies the structural break between 1981 and 1986, then the marginal effect of the mortgage-carrying-cost-to-income ratio should increase between 1981 and 1986. That is, the risk-adjusted net present value of interest payments over the amortized life of the

mortgage would be higher for a given carrying cost, effectively raising the cost of homeownership. To account for rising interest rate risk in the model, the mortgage-carrying-cost-to-income ratio is interacted with a binary variable for the years 1986 to 2006 for both couples with children and non-family individuals (see Table 11 and Table 12). As expected, the marginal effect of mortgage-carrying costs rises between 1981 and 1986 for households in the middle and top income quintiles, irrespective of household type. There is no differential effect for households in the lowest income quintile. This result also holds qualitatively when the model is run separately by year, an approach that allows all the coefficients to vary over time.

It is also apparent from both tables that, after permitting the marginal effect of mortgage-carrying costs to vary between 1981 and the post-1981 period, the year binary variables essentially return to their original levels. The model, by and large, does not account for the differential trends in homeownership across income classes. However, it does provide evidence that households became more sensitive to interest rate risk over the period. It is declining mortgage-carrying costs (see Table 4), particularly after 1991, that compensated for the effect of higher interest rate risk on the decision to own.

Table 11

Marginal effects of the odds of owning a home, controlling for the post-1981 change in the ratio of mortgage-carrying cost to income, households aged 20 to 39 — Couples with children (selected variables)

	Income quintile					
	Bottom		Middle		Top	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
Year binary variables						
1986	-0.053	0.000	0.015	0.038	0.010	0.026
1991	-0.117	0.000	0.064	0.000	0.031	0.000
1996	-0.151	0.000	-0.019	0.010	0.025	0.000
2001	-0.151	0.000	-0.037	0.000	0.016	0.000
2006	-0.099	0.000	-0.021	0.008	0.035	0.000
Mortgage-carrying cost to income	-0.00001	0.974	-0.066	0.000	-0.015	0.001
Mortgage-carrying cost to income x post 1981	0.00001	0.961	-0.165	0.000	-0.073	0.000
	Income quintile					
	Bottom		Middle		Top	
Number of observations	60,569		188,767		150,880	
Pseudo *R-squared*	0.152		0.068		0.055	
Wald chi-square	7,893		12,032		4,755	
Log pseudo likelihood	-164,404		-541,817		-231,296	

Notes: The mortgage-carrying-cost-to-income ratio has been normalized by the standard deviation of the variable across the sample, excluding the top and bottom 5% of households based on household income. The coefficients measure the change in the dependent variable resulting from a one-standard-deviation change in the independent variable.

Sources: Statistics Canada, Census of Population (1981 to 2006) and Survey of Financial Security (1999 and 2005).

Table 12

Marginal effects of the odds of owning a home, controlling for the post-1981 change in the ratio of mortgage-carrying cost to income, households aged 20 to 39 — Non-family individuals (selected variables)

	Income quintile					
	Bottom		Middle		Top	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
Year binary variables						
1986	0.004	0.345	-0.002	0.916	0.031	0.244
1991	-0.003	0.431	0.093	0.000	0.175	0.000
1996	0.005	0.172	0.085	0.000	0.135	0.000
2001	0.025	0.000	0.095	0.000	0.051	0.050
2006	0.104	0.000	0.222	0.000	0.163	0.000
Mortgage-carrying cost to income	-0.000003	0.746	-0.040	0.000	-0.055	0.023
Mortgage-carrying cost to income × post 1981	0.000004	0.591	-0.068	0.000	-0.246	0.000

	Income quintile		
	Bottom	Middle	Top
Number of observations	117,665	81,056	23,920
Pseudo *R-squared*	0.090	0.085	0.081
Wald chi-square	6,444	6,196	1,971
Log pseudo likelihood	-227,443	-244,403	-81,491

Notes: The mortgage-carrying-cost-to-income ratio has been normalized by the standard deviation of the variable across the sample, excluding the top and bottom 5% of households based on household income. The coefficients measure the change in the dependent variable resulting from a one-standard-deviation change in the independent variable.

Sources: Statistics Canada, Census of Population (1981 to 2006) and Survey of Financial Security (1999 and 2005).

6 Conclusions

Throughout the 1980s and the 1990s and into the mid-2000s, an increasing proportion of Canadians owned, rather than rented, their homes. This is a trend that would have been even stronger if it were not for the tendency for Canadians to delay family formation, which often coincides with the purchase of a first home.

Beyond demographic factors, the household's decision to own is associated with fundamental economic incentives. Households are more likely to choose to own their homes when the cost of owning falls, either relative to renting or when the cost of borrowing declines relative to incomes. It is also the case that the marginal effect of the cost of borrowing increased significantly between 1981 and 1986. This is consistent with rising interest rate risk. Homeownership rates were maintained or rose through the period because rising interest rate risk was counterbalanced by falling mortgage costs. As well, there is evidence that households are also more likely to own when they expect a greater capital gain from investing in a home.

Tenure choice does not depend only on relative costs. Tax incentives and borrowing constraints are also associated with the decision to own. Households with higher permanent incomes are more likely to own. This is consistent with owning a home providing a tax advantage for higher-income homeowners with higher marginal tax rates. Households are also more likely to own when they have sufficient wealth for a standard down payment. This is consistent with borrowing constraints (i.e., minimum down payment requirements) negatively affecting the ability of households to finance a home.

Although homeownership has become an increasingly popular alternative to renting, this trend is not universally true of all households. Young lower-income households, especially couples with children, increasingly rent instead of own. In contrast, non-family individuals have turned progressively more to owning. This is true of both lower- and higher-income households of this kind; albeit the trend is stronger for higher-income households. After accounting for standard demand-side economic incentives, these essential trends in the data generally remain, which is suggestive of changes in the underlying structure of the housing market.

7 Appendix: Propensity score matching

Propensity score marching (PSM) refers to the pairing of treatment and control units with similar values on the propensity score and other covariates. As discussed in Dehejia and Wahba (2002), PSM is a more efficient means of creating a matched set than relying on cross-tabulating the data on a set of characteristics of the potential control group. Moreover, even when Census data is used, cross-tabulating data by dwelling characteristics and region can result in many cells with few observations. Given that rental and owner-occupied dwelling stocks are quite different, making direct comparisons of their relative cost is perilous at best. Using a PSM model can help alleviate this problem by creating treated and control groups (owner-occupied homes and rental homes) whose underlying characteristics are adjusted such that both groups, on average, look the same.

An alternative to cross-tabulating data and PSM is to use hedonic techniques, the standard method used to measure the value of housing services for owner-occupied housing. In other work (Brown *et al.* 2010), hedonic techniques were found to perform well for much of the housing stock, but were not effective at predicting rents from dwellings whose value falls in the upper quintile. Because PSM attempts to match similar dwellings, it has the potential of being more effective in accurately measuring the rents of more expensive homes. This is of particular concern in this analysis because of the differing behaviours of lower- and higher-income households.

There are various propensity score matching techniques, including nearest-neighbour matching (or one-to-one matching with replacement) and kernel-based matching. The nearest-neighbour approach matches households in the treatment group to households with the closest propensity score. The kernel-based approach matches each household in the treatment group to a weighted sum of households that have similar propensity scores, with the greatest weight being given to households with closer scores. The latter method is assumed to be more efficient, since nearest-neighbour matching tends to discard a large amount of information from the control group. However, because kernel-based matching is computationally intensive and the sample is sufficiently large in most instances to permit discards without too much loss of information, nearest-neighbour matching was chosen.

The PSM model is estimated separately for each year and for each geographic market. Geographic markets are defined as metropolitan areas (CMAs and CAs), with the non-metropolitan portion of provinces divided into MIZs. This will allow variability across local housing markets. The PSM model is a function of dwelling and location characteristics, and is specified as:

$$\Pr(Own) = f\left(Type_i, Rooms_i, Neighbourhood_i\right),$$

where: Pr*(Own)* is the probability of owning a home; $Type_i$ is the type of dwelling; $Rooms_i$ is the number of rooms; and $Neighborhood_i$ includes a set of neighbourhood characteristics including the median income in the neighbourhood, the proportion of owner-occupied dwellings, and the proportion of university-educated adults. From this logistic regression, homes with similar probabilities of being a rental are matched such that the overall distribution of the cost of owning a home is predicted for renters, on the basis of the matching process that matches owner-occupied dwellings to rental dwellings with similar characteristics. Finally, the cost of renting relative to owning a home is determined for each household by using only the matched data.

Propensity score matching tests were conducted to determine whether the averages for each variable in the model were statistically different for the matched sample. The results are shown in Table 13 for selected metropolitan areas (Halifax, Toronto, and Calgary) for 2006.

In general, the matching routine worked well. While a statistically significant difference between the treated and control groups remained after the matching was complete, the deviation between the treated and untreated groups was often quite small. For instance, only 7% of the treated group consisted of apartments, while 77% of the control group in Halifax consisted of apartments. After matching, 6% of the treated and control groups consisted of apartments.

Table 13

Propensity score matching tests for Halifax, Toronto, and Calgary, 2006

	Halifax				Toronto				Calgary			
	Treated	Control			Treated	Control			Treated	Control		
	mean	mean	t-test	p-value	mean	mean	t-test	p-value	mean	mean	t-test	p-value
Dwelling types												
Semi-detached												
Unmatched	0.08	0.05	10.0	0.000	0.11	0.02	90.5	0.000	0.05	0.07	-6.8	0.000
Matched	0.07	0.07	-1.6	0.101	0.11	0.13	-22.3	0.000	0.06	0.06	0.0	0.969
Row house												
Unmatched	0.03	0.04	-4.2	0.000	0.09	0.06	33.2	0.000	0.08	0.12	-19.3	0.000
Matched	0.03	0.02	0.3	0.763	0.09	0.10	-8.6	0.000	0.08	0.08	-1.5	0.137
Duplex												
Unmatched	0.03	0.06	-13.6	0.000	0.04	0.05	-11.6	0.000	0.02	0.09	-47.5	0.000
Matched	0.02	0.02	-1.0	0.341	0.04	0.03	6.4	0.000	0.02	0.02	4.3	0.000
Apartment												
Unmatched	0.07	0.77	-179.9	0.000	0.17	0.81	-469.3	0.000	0.10	0.54	-154.6	0.000
Matched	0.06	0.06	1.1	0.267	0.16	0.17	-12.7	0.000	0.10	0.10	-0.8	0.411
Mobile												
Unmatched	0.03	0.01	15.2	0.000	0.00	0.00	1.0	0.322	0.01	0.00	2.3	0.024
Matched	0.03	0.03	0.7	0.515	0.00	0.00	0.6	0.560	0.01	0.01	0.5	0.647
Number of rooms												
Number of bedrooms												
Unmatched	3.11	1.78	120.9	0.000	3.19	1.62	409.5	0.000	3.19	2.00	138.2	0.000
Matched	3.14	3.14	-0.1	0.935	3.22	3.25	-8.0	0.000	3.15	3.26	-17.8	0.000
Number of other rooms												
Unmatched	4.62	2.75	93.5	0.000	4.11	2.51	279.8	0.000	4.33	2.83	103.7	0.000
Matched	4.68	4.70	-1.0	0.326	4.15	4.13	3.6	0.000	4.14	4.10	3.9	0.000

See note at end of table.

Table 13
Propensity score matching tests for Halifax, Toronto, and Calgary, 2006 (concluded)

	Halifax				Toronto				Calgary			
	Treated	Control			Treated	Control			Treated	Control		
	mean	mean	t-test	p-value	mean	mean	t-test	p-value	mean	mean	t-test	p-value
Dissemination area characteristics												
Median income (log)												
Unmatched	11.03	10.60	99.6	0.000	11.22	10.72	353.6	0.000	11.25	10.81	150.2	0.000
Matched	11.05	11.00	14.6	0.000	11.23	11.19	32.6	0.000	11.24	11.18	28.3	0.000
Proportion owned dwellings												
Unmatched	0.80	0.35	154.7	0.000	0.82	0.37	534.6	0.000	0.83	0.47	209.1	0.000
Matched	0.81	0.79	6.9	0.000	0.82	0.81	15.5	0.000	0.82	0.81	13.3	0.000
Proportion of dwellings 20 years old												
Unmatched	0.62	0.71	-28.0	0.000	0.58	0.78	-152.4	0.000	0.50	0.78	-87.4	0.000
Matched	0.61	0.63	-6.2	0.000	0.58	0.56	19.4	0.000	0.51	0.51	0.7	0.499
Proportion of dwellings needing major repairs												
Unmatched	0.06	0.08	-19.8	0.000	0.05	0.08	-170.7	0.000	0.04	0.07	-69.5	0.000
Matched	0.06	0.07	-16.3	0.000	0.05	0.05	4.4	0.000	0.04	0.04	-3.8	0.000
Log median value of owned houses												
Unmatched	10.59	3.51	130.6	0.000	11.50	4.14	446.1	0.000	11.55	5.48	171.7	0.000
Matched	10.75	10.71	1.3	0.213	11.55	11.70	-13.8	0.000	11.51	11.46	2.4	0.015
Proportion of university-educated adults												
Unmatched	0.31	0.35	-15.8	0.000	0.37	0.38	-14.8	0.000	0.35	0.34	7.0	0.000
Matched	0.31	0.31	-0.6	0.538	0.37	0.38	-7.6	0.000	0.35	0.34	11.0	0.000
Proportion of low- income individuals												
Unmatched	0.08	0.19	-100.3	0.000	0.11	0.23	-323.6	0.000	0.09	0.18	-135.6	0.000
Matched	0.07	0.08	-0.6	0.542	0.11	0.11	-13.4	0.000	0.09	0.09	-13.4	0.000
	Halifax				Toronto				Calgary			
Number of observations	29,904				348,272				80,871			

Source: Statistics Canada, Census of Population, 1981 to 2006.

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